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ABSTRACT

This paper describes Project SMART (Science and Math Access: Resources & Technology), a multi-year professional development effort that includes components for all adults who regularly have contact with children with disabilities. The common goal of each of the components is the development of both efficacy and capacity to inspire children with disabilities to overcome challenges in the pursuit of excellence in math and science education. While the emphasis of the program has been on inservice teacher education, components have been developed for the following groups that support the efforts of children: general education teachers, special education teachers, parents of children with disabilities, and guidance counselors. The model program is intended to promote positive and permanent changes in the academic climate of classrooms and to provide teachers and other service providers with access to appropriate instructional materials, educational technologies, and hands-on experiences to insure full participation in science and mathematics by students with differing abilities. The teacher component focuses on collaborative teaching, upgrading knowledge of math and science subject matter, and identifying and practicing alternative approaches for teaching science and math. The technology training program is described, along with the program for parents and guidance counselors. (CR)

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PROJECT SMART - SCIENCE AND MATH ACCESS: RESOURCES & TECHNOOLOGY

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Introduction

Project SMART (Science and Math Access: Resources & Technology) has evolved into a multi-year professional development effort that includes components for all adults who regularly have contact with children with disabilities. The common goal of each of the components is the development of both efficacy and capacity to inspire children with disabilities to overcome challenges in the pursuit of excellence in math and science education. While the emphasis area of our program has been in-service teacher education, components have been developed for the following groups that support the efforts of children:

- general education teachers;
- special education teachers;
- parents of children with disabilities;
- guidance counselors;

The model is intended to promote positive and permanent changes in the academic climate of classrooms and to provide teachers and other service providers with access to appropriate instructional materials, educational technologies, and hands-on experiences to insure full participation in science and mathematics by students with differing abilities.

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Component for Teachers

Our model for professional development is designed to link those factors that impact on student outcomes, which include teacher practices and interventions (i.e., the strategies and adaptations for the teaching of science and mathematics) and teachers' attitudes concerning instruction (Allinder, 1994). Consistent with Allinder's findings and the need for inclusive practices, the program is also designed to involve, from each school, a team that includes a special education teacher and a general education teacher, or a team of teachers working in an inclusionary environment. As we conclude our third year,

we have worked with approximately 75 teachers, providing them with summer experiences that incorporate certain guiding principles from the research literature on professional development:

- Change in teacher practice is a gradual process.
- Regular feedback is essential.
- Opportunities for reflection and discussion with peers is essential.
- Continued support is needed throughout the academic year.

The model is designed to provide teachers with access to appropriate instructional materials, educational technologies and hands-on experiences. This is accomplished by reinforcing formal training activities with practicum experiences where a small number of children are taught by workshop participants. The practicum provides teachers with the opportunity to practice their skills in a sheltered environment as the students benefit from highly desirable teacher to student ratios.

The summer training program focuses on collaborative teaching, upgrading knowledge of math and science subject matter, and identifying, integrating and practicing alternative approaches for teaching science and math which address the needs of the special education students. The first week of the summer program concentrates on the preparation of the participants for the upcoming practicum through the introduction of science and math activities that expose the participants to new concepts, interactive training in science and mathematics methodologies, and adaptations for teaching students with disabilities. At this same time the teachers are instructed in the use of computer technology in the classroom.

The practicum provides a controlled classroom environment with children from special education programs. Daily lesson plans and assessment of practicum activities are used to assess the effectiveness of the lessons taught. The small group scenario provides maximum benefit to the students and allows the educators the opportunity to work collaboratively to try out the skills and content acquired in the traditional professional development mode and be able to reflect on their efforts to use recently acquired skills. They also receive feedback prior to returning to the classroom to implement the acquired skills and knowledge. Our evaluation of lessons and student work, and teacher feedback, allow us to learn of new and thoughtful ways to adapt lessons and make accommodations for the children. In short, practicum teaches the staff how to improve science and math education for children with disabilities.

This model is consistent with other efforts which suggest that self-confidence and positive beliefs are prerequisites for change, and that the teacher's belief in being able to cause change (i.e., can affect student learning outcomes) is a necessary prerequisite to achieve positive learning outcomes for students (Haney, Czerniak, & Lumpe, 1996). By bringing in children with special needs to be part of the training program, teachers are able to see desired learning outcomes for children resulting from their new skills.

The New Jersey State Content Standards for Science and Mathematics are an integral part of the professional development program. In both science and mathematics, specific standards refer to the use of technology as a tool to understand basic concepts. Substantial amounts of time are spent in exploring their meaning and implementation. All science and mathematics activities are aligned with these standards, indicative of the great importance placed on using the standards throughout the program. We want the teachers to think about the standards while they are doing science and math during the practicum, and how they complement the curriculums in their own schools.

The academic year programs are interactive in nature, designed to create an awareness of the nature of various disabilities, and provide the opportunity to learn about and discuss techniques of adapting instruction to specific disabilities. The teachers continue their training on content and methodologies. Special programs focus on such areas as: planning lessons to meet the needs of all students; how to develop an IEP for achievement; curriculum frameworks in support of standards; and self-assessment of adapting activities and lessons to meet the needs of all children.

Technology Training

Educational technology can be a powerful force for change in education. However, technology can not be considered a panacea for educational reform (Kimmel and Deek, 1995). Technology, when properly used as an integral part of the curriculum and the instructional approach, can be a very effective tool for improving and enhancing instruction and learning experiences in the content areas involving all students in complex, authentic tasks. Technology, as a tool in the classroom, has the potential to dramatically change the way we view science and mathematics for all students, especially for students with special needs, and support the kind of student learning advocated by current educational reform. However, enabling students to benefit from such tools goes beyond the availability of technology in many school systems. Teachers must be ready and equipped to prepare and deliver instruction using new approaches which include technology and hands-on and collaborative teaching.

The training program is designed as a teacher-centered, diagnostic, prescriptive program, geared to teachers' concerns and needs to best facilitate change. A PC computer-based instructional laboratory provides teachers with the necessary environment for exploring and testing new approaches and strategies. The training is based on the premise that appropriate use of educational technology requires that teachers have been provided with solid foundations in the general applications of technology in education. This must lead to a level of comfort in using hardware and software systems that enables the teachers to utilize the technology integrated within the scope of the curriculum and subject matter they are teaching and to be able to make decisions for varying situations. Ultimately, as technology continues to evolve and other needs arise, teachers will be faced with some decision making situations and have to be equipped to make them do it. This requires skills such as evaluation and selection of hardware and software that are effective and efficient for specific applications.

Consistent with the literature (Lehman, 1994). a survey of participants indicated that very few had any extensive in-service technology training and that more than fifty percent of them had no training. Thus, participants were first introduced to basic information and terminology and an overview of the computer from the hardware, software, and applications viewpoint, including the different components of the machine and the operating system functions, windows navigation, file management, word processing, and presentation/desktop publishing. This focus was necessary to provide the teachers with the essential knowledge for carrying out discussions about the technology and to serve as a foundation for subsequent training sessions. Hands-on exercises were integrated into the coverage of each application. A discussion of the similarities and differences between the windows platform and the Mac platform was included so that teachers would be comfortable with either machine. In addition, much of the computer use in the practicum utilized Powerbooks.

Discussion of classroom applications included a hands-on introduction to a database management system with plotting capabilities for data visualization as well as computing manipulative functions. The software selected for use had versions in both platforms. Projects encompassing the use of the full functionality of the system were presented to them and solved by all participants. For example, one project used a predefined database dealing with attributes of animals. Teachers were asked to create queries on the database in order to create graphical interpretations of the data. The teachers were also asked to organize and present their findings using the built-in slide show feature. Each teacher gave a presentation to the entire group and group discussions followed each presentation. Following the introduction of the advanced functions of a database management system with plotting and data visualization capabilities, the teachers were asked to choose a problem relevant to a subject matter of their class and adapt it to the software. The goal was to get the teachers to create their own database using their own data and, then, report on how it may be possible to use a database management system in the classroom to organize, manipulate, retrieve, and present this information. Each participant was asked to discuss their findings and to demonstrate their results to all other participants.

Additional workshops focused on teacher requests overall class management concerns, electronic lesson preparation/presentation, and problem solving software. As an example, an overview of TesselMania (a geometry application that covers transformations, symmetry, and patterns) was provided. Teachers were asked to prepare and present a short lesson plan using the TesselMania software. Powerpoint, which had

been covered in earlier workshops, was used to create the material for presentation. Sessions on software review were designed to provide the teachers with a greater exposure to math and science applications. In one session, eight different software packages were made available in the lab for explorations and review. Teachers we asked to sample one or more systems, choose one for careful analysis, and write a report about the application they used including a summary of functions and suggestions for integration into the classroom. The written reports were compiled and copies were provided to all teachers. The Internet was introduced as a valuable educational tool, when it can serve as a source of high-quality, reliable, and relevant information that can be effectively adapted to educational needs.

The Program for Parents Of Children With Disabilities

Parental involvement is a key factor in student achievement. Awareness and educational programs are provided for parents of children being served by participating districts. The intent is to increase participation of parents in the educational process by providing them with programs which promote the concept that all children can acquire the knowledge and skills necessary to meet challenging standards in inclusionary and general education classrooms. Parent training sessions have focused on: the IEP process, basic rights in Special Education, family math and science, conflict resolution, and 504 compliance. Our expectations are that parents become: a) teachers, b) partners, c) decision makers, and d) advocates for their children's education.

The Program for Guidance Counselors and Child Study Teams

Programs for counselors focus on topics that cut across different responsibilities of teachers, counselors, child study team personnel and administrators. For example, a link between teacher training and the concern for student achievement is provided by an interactive workshop on "How to Develop an IEP for Achievement." The workshop explores methods for maximizing the achievement and development of students with disabilities, with an emphasis on the state content standards. The programs seek to raise the awareness of participants of the bridging mechanisms that facilitate educational transition for individuals with disabilities in SEM courses between elementary and secondary grade level, and strategies that empower parents so that they can enable their children to pursue SEM options. Additionally, workshop participants meet and interact with practicing scientists and engineers who have disabilities.

Discussion

The project seeks to provide teacher participants with the training and tools so that they can meet the needs of all the children in their classrooms, and provide the children with the opportunities to demonstrate that they have acquired the skills and knowledge of the New Jersey Core Content Standards. Initial evaluations suggest that we have been successful in this endeavor.

The program goals and objectives have centered on teacher professional growth in the areas of teacher attitude, teaching skills, and curriculum writing skills. Assessment of teacher growth has been informal through a comparison of skill and knowledge acquisition by teacher cohorts in comparison with the time each cohort has spent in the program. The instrument used to assess teacher growth used descriptions of

classroom situations calling for participants to make instructional decisions. The written responses by teachers to these situation were then evaluated to identify learned skills and knowledge that teachers said they would apply to the situation described. Initial data indicates that teachers, who have been in the program longer, were better able to suggest appropriate role descriptions and/or instructional accommodations. Teachers with less time in the program could not recommend either an appropriate accommodation or instructional adaptation. The pattern of teacher professional growth suggests that teachers with greater exposure to our professional development program exhibit more comprehensive skills in planning instruction to meet the needs of students with disabilities.

Our project has been seeking the answer to the question: How do we meet the special needs of children in the learning of science, both in self-contained classrooms and in inclusionary settings? Teachers need help to bridge the gap between an understanding of the need for adaptations for students with special needs and putting those adaptations into practice in a classroom of students with differing needs. We have found that appropriate activities in a professional development program will provide progress in developing the skills and knowledge of teachers in the teaching of science and math to children with disabilities. While our teachers demonstrated the knowledge to discuss generic adaptations for students, their greatest need was support in the application of adaptations and modifications to specific situations for students with diverse needs, especially in an inclusive environment.

The transfer of the technology training into classroom instruction is uncertain and inconsistent at this time, largely due to the lack of availability of hardware and/or appropriate software in the home schools. Documentation of successes at this time is largely anecdotal in nature. One teacher used the web as a part of a science lesson on aerodynamics in the summer practicum, and then later used it in her classroom. Other teachers integrated software, such as Sammy Science and TesselMania, into their science and math lessons during the practicum. Another teacher fulfilled the requirements for graduate credit by developing and field-testing a science unit which included the integration of technology into the learning process.

Conclusion

Thanks to continuing funding of our current NSF grant (Award #HRD- 9450074), we are now adapting our program for dissemination in state and regional centers, and school districts. It is our intention to enhance our model and bring it to a wider audience of teachers and other service providers.

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